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(54) **SYSTEM AND METHOD FOR PREVENTING UNAUTHORIZED WIRELESS COMMUNICATIONS**

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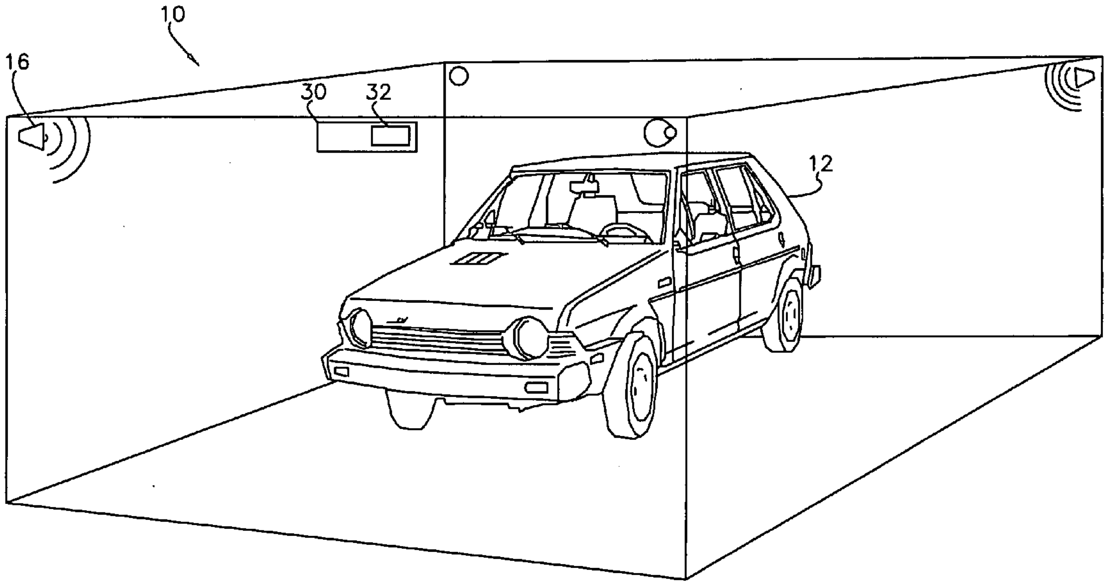
(57) **ABSTRACT**

A monitoring system and method for controlling access to, and especially protecting against unauthorized requests to provide input to, e.g., program, or elicit output from, a vehicular or other mobile device, such as an electronic control unit (ECU), adapted for use with the system, wherein said system, in a preferred embodiment, is configured to receive the request within a safe-zone, block its execution by the vehicle, send an objection message back to the source, and send a report to a law enforcement agency, based on the location of the source of the request.



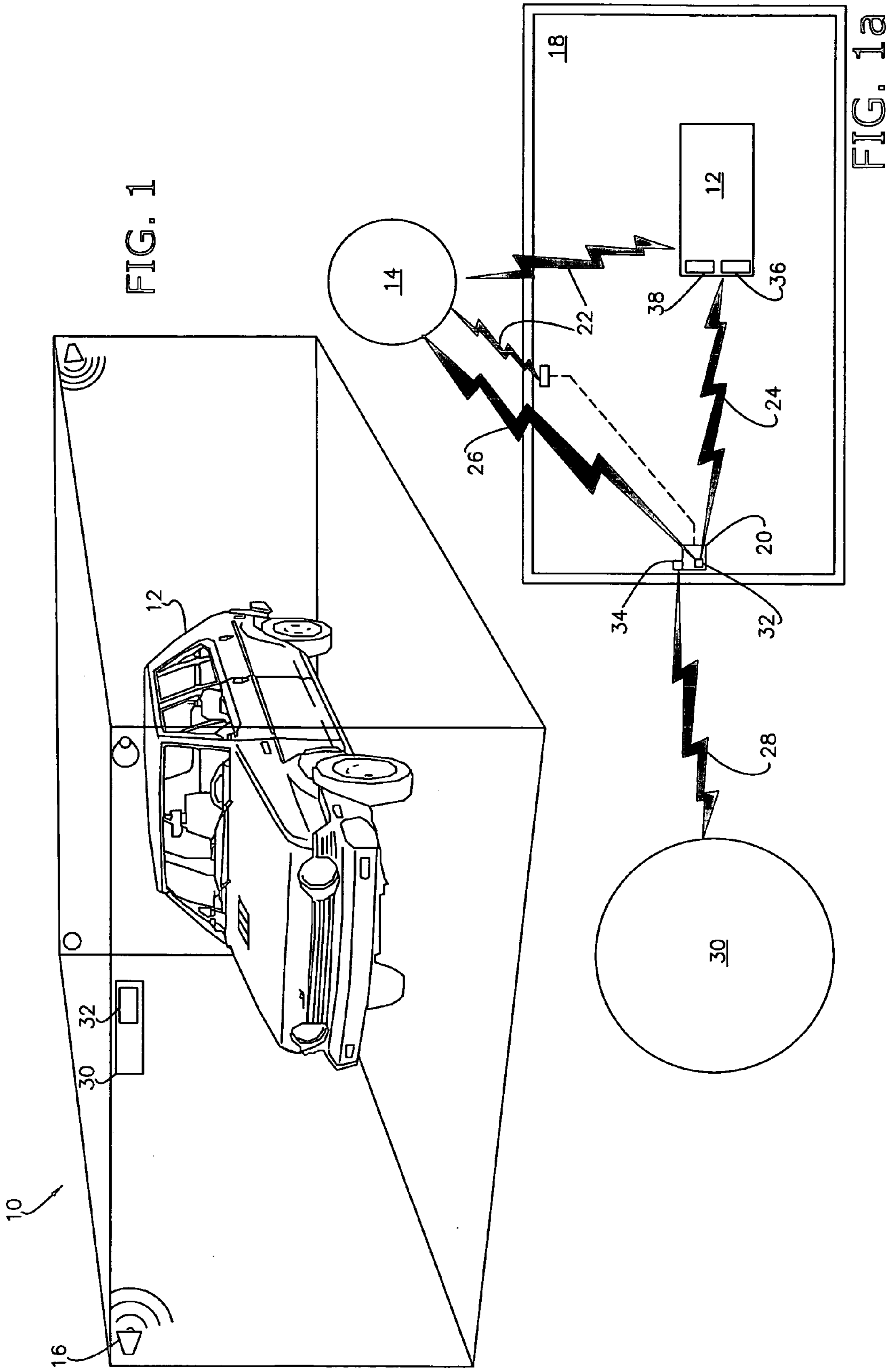


FIG. 1

FIG. 1a

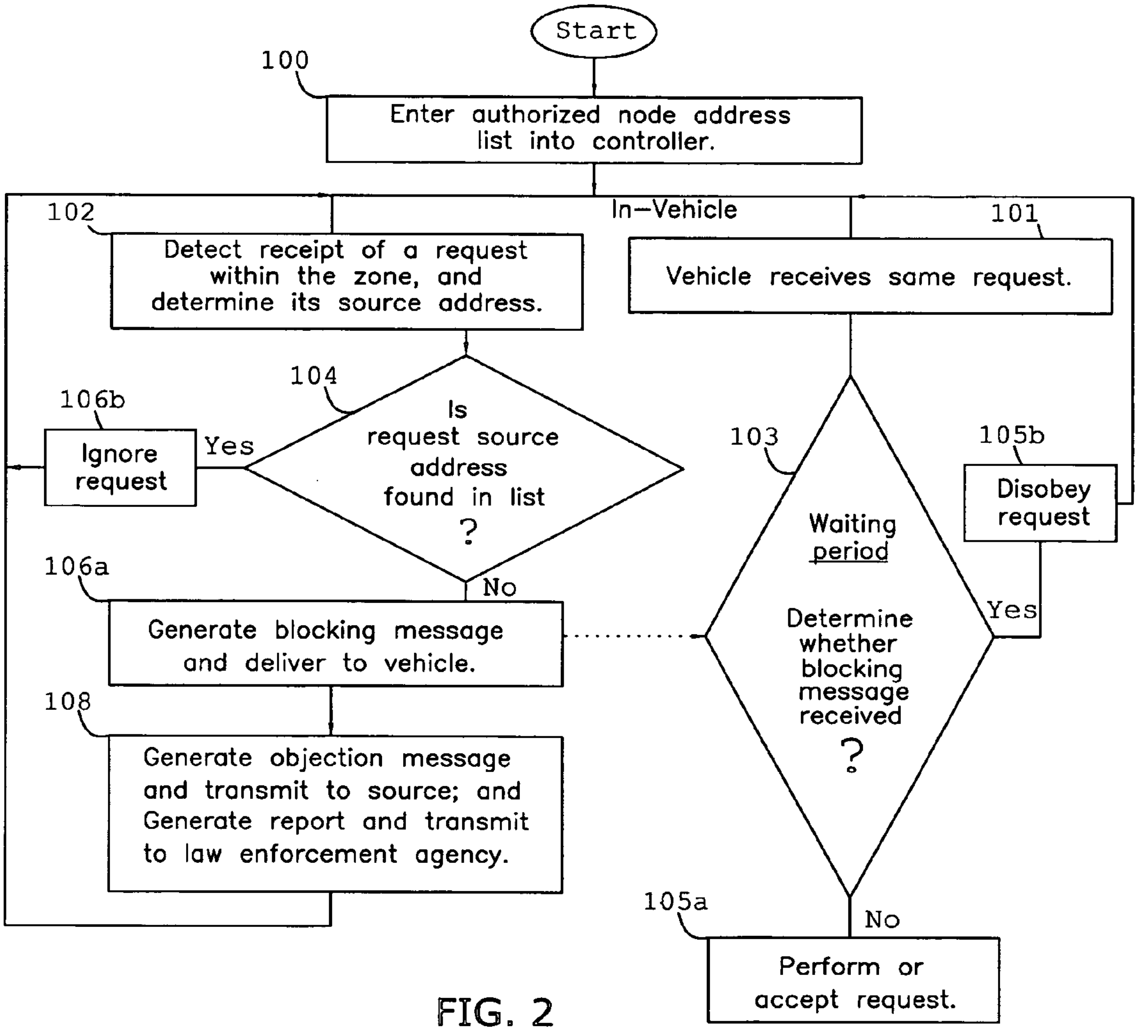

Start
100
Enter authorized node address list into controller.
In–Vehicle
102
Detect receipt of a request within the zone, and determine its source address.
101
Vehicle receives same request.
104
Is request source address found in list ?
106b
Ignore request
Yes
No
103
Waiting period
Determine whether blocking message received ?
105b
Disobey request
Yes
106a
Generate blocking message and deliver to vehicle.
108
Generate objection message and transmit to source; and Generate report and transmit to law enforcement agency.
105a
No
Perform or accept request.

FIG. 2

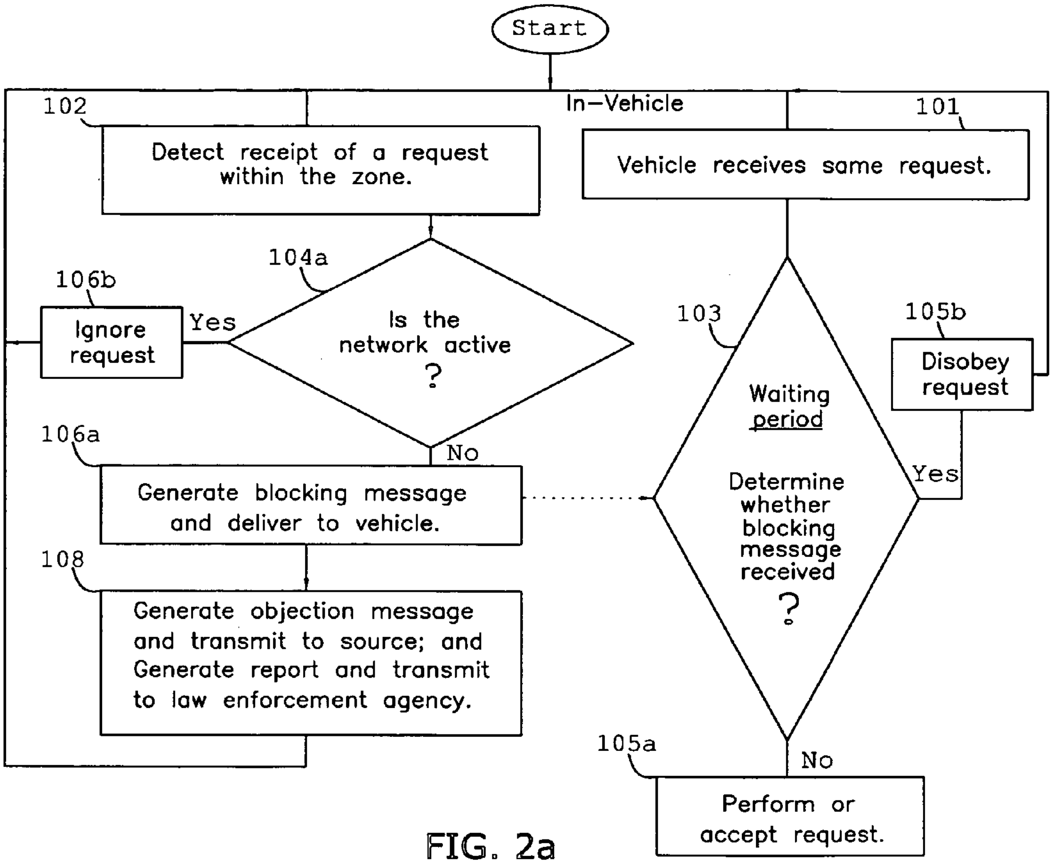

Start
In-Vehicle
102
Detect receipt of a request within the zone.
101
Vehicle receives same request.
104a
106b
Ignore request
Yes
Is the network active ?
103
105b
Disobey request
Waiting period
Determine whether blocking message received ?
Yes
106a
No
Generate blocking message and deliver to vehicle.
108
Generate objection message and transmit to source; and Generate report and transmit to law enforcement agency.
105a
No
Perform or accept request.

FIG. 2a

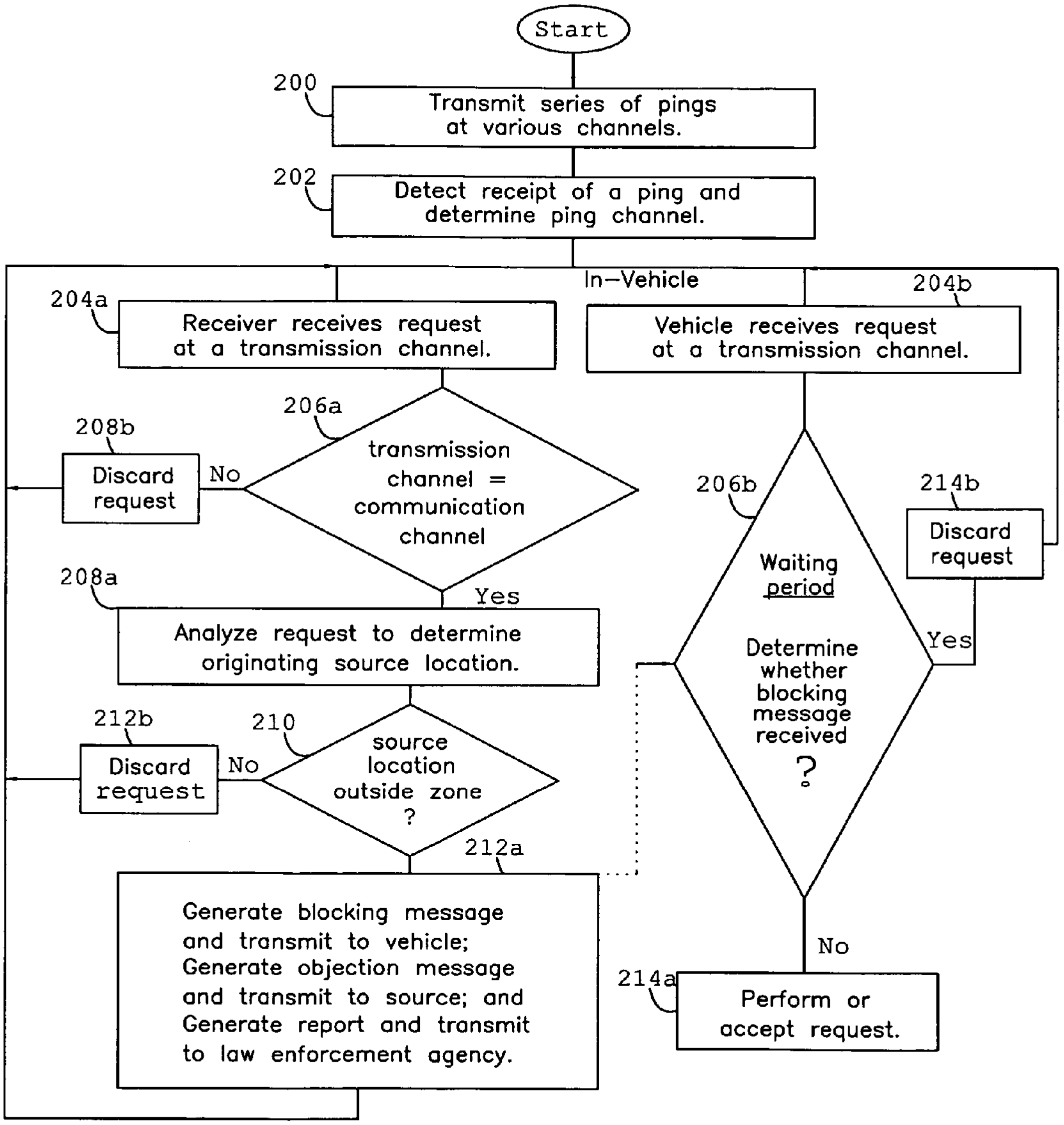

Start
200
Transmit series of pings at various channels.
202
Detect receipt of a ping and determine ping channel.
In–Vehicle
204a
Receiver receives request at a transmission channel.
204b
Vehicle receives request at a transmission channel.
206a
transmission channel = communication channel
208b
Discard request
No
Yes
208a
Analyze request to determine originating source location.
210
source location outside zone ?
212b
Discard request
No
212a
Generate blocking message and transmit to vehicle; Generate objection message and transmit to source; and Generate report and transmit to law enforcement agency.
206b
Waiting period
Determine whether blocking message received ?
214b
Discard request
Yes
No
214a
Perform or accept request.

FIG. 3

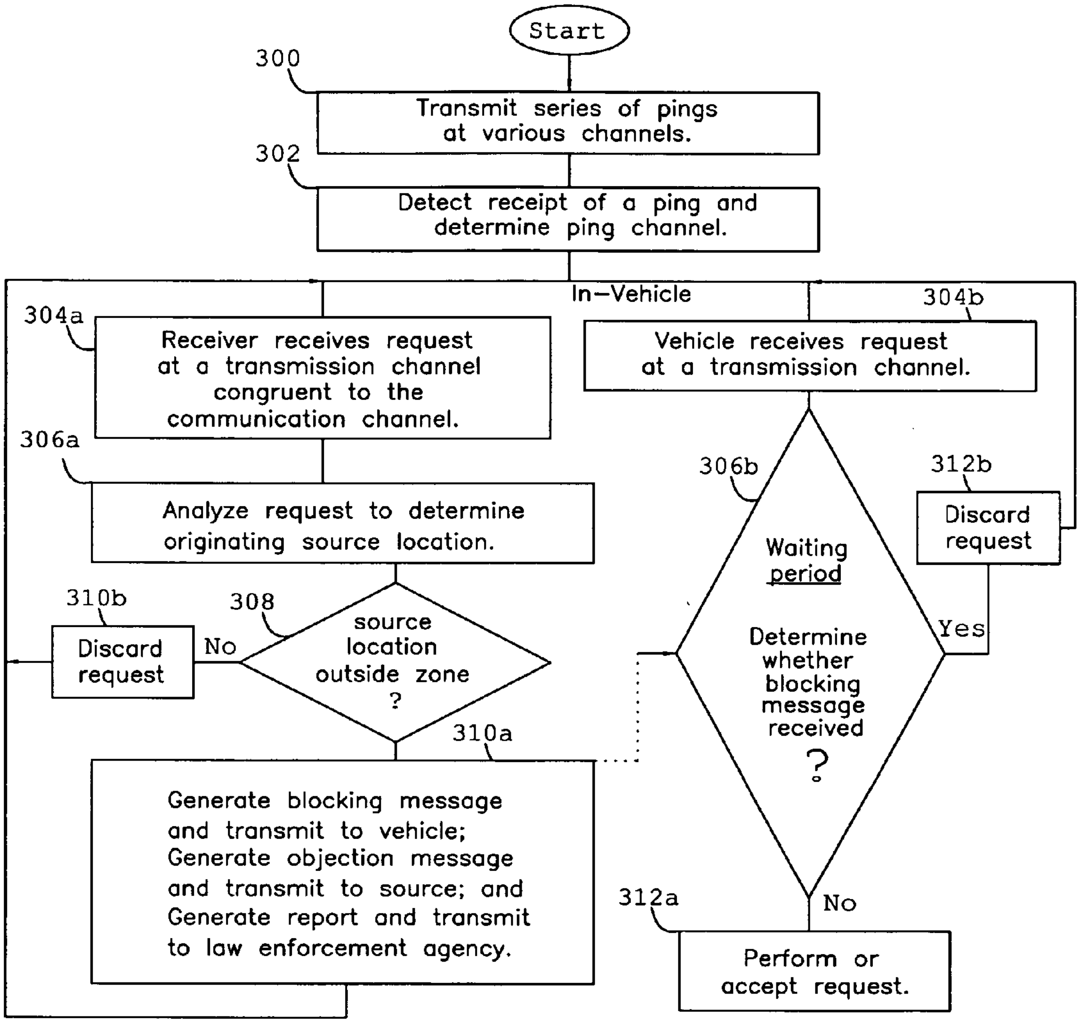

Start
300
Transmit series of pings at various channels.
302
Detect receipt of a ping and determine ping channel.
In–Vehicle
304a
Receiver receives request at a transmission channel congruent to the communication channel.
304b
Vehicle receives request at a transmission channel.
306a
Analyze request to determine originating source location.
306b
Waiting period
Determine whether blocking message received ?
312b
Discard request
Yes
310b
Discard request
No
308
source location outside zone ?
310a
Generate blocking message and transmit to vehicle; Generate objection message and transmit to source; and Generate report and transmit to law enforcement agency.
312a
No
Perform or accept request.

FIG.4

SYSTEM AND METHOD FOR PREVENTING UNAUTHORIZED WIRELESS COMMUNICATIONS

TECHNICAL FIELD

[0001] The present invention relates to systems and methods for controlling access to vehicular or other mobile devices. More specifically, the present invention concerns a system and method for controlling access to, and especially protecting against unauthorized attempts to provide input to, e.g., program, or elicit output from, a vehicular or other mobile device, such as an electronic control unit, wherein at least one monitoring device is configured to determine an outside-originating communication.

BACKGROUND OF THE INVENTION

[0002] In the prior art, programming a vehicular electronic control unit (ECU) requires that the vehicle be present at an authorized location (e.g., a manufacturing or assembly facility, a dealership, or an authorized repair facility) and directly hardwired to a programming tool. Recently, remote wireless programming of ECUs has been developed to allow greater programming flexibility. With this change, security has shifted from physical mechanisms to password, gateway, and cryptographic authentication mechanisms for controlling access. Unfortunately, the security afforded by these wireless access-control algorithms does not provide a sufficiently high level of assurance against malicious attacks, such as, for example, the communication of viruses or other harmful or undesired programs to ECUs. Where a malicious communicator has access to the password or cryptographic key, and the gateway provisions are true (e.g. the vehicle or device is at an authorized location), the communication will be accepted.

[0003] It will be appreciated that this concern extends to programming (e.g. corruption), providing input to (e.g. virus downloading), or eliciting output from (e.g. theft, spying, etc.) vehicular ECUs or other mobile devices, including, for example, mobile telephones and mobile computing devices. As telematic applications, and wireless communication capability among devices become increasingly prevalent, the ability to discern an authorized communication becomes increasingly significant. Toll booths or parking garages, for example, might be adapted to wirelessly query vehicles for identification or even for payment information, but, as mentioned, password and cryptographic mechanisms do not afford sufficient security against the illicit collection of such information.

[0004] Thus, an improved system and method of controlling access to a vehicular ECU or mobile device is needed.

SUMMARY OF THE INVENTION

[0005] The present invention provides a monitoring system and method for controlling access to, and especially protecting against unauthorized attempts to provide input to, e.g., program, or elicit output from, a vehicle or other mobile device, such as an ECU. The system is useful, among other things for providing an added layer of security, when used in conjunction with password, cryptographic, or gateway mechanisms, by preventing communication between the target and an originating source outside of a predetermined authorization zone.

[0006] A first aspect of the present invention concerns a method of controlling access to a mobile device within an authorized zone having a communications network. A preferred embodiment of the method includes the steps of determining and storing a list of the node addresses of the network, detecting a wireless request within the zone, comparing the address of the source of the request to the addresses in the list, and blocking delivery of the request to the mobile device, when the originating source address is not found in the list.

[0007] A second aspect of the present invention concerns a method of controlling access to a mobile device within an authorized zone. The method comprises the steps of determining the presence of the mobile device within the zone, determining and storing at least one communication channel of the mobile device, detecting a wireless request within the zone, and determining the transmission channel of the request, comparing the transmission channel to the communication channel of the mobile device, determining the location of the originating source of the request, when the transmission channel is congruent to the communication channel, and denying acceptance of the request by the mobile device, if the originating source is located outside of the zone.

[0008] A preferred embodiment of the system includes at least one receiver oriented and configured to detect a wireless request within the zone, a controller, and at least one transmitter communicatively coupled to said at least one receiver and mobile device. In another aspect of the invention, the system and method is configured to detect only requests having transmission channels congruent to the communication channel of the mobile device.

[0009] It is appreciated that the system and method may be used in conjunction with one or more other independent access-control mechanisms, such as a physical, password, or cryptographic authentication mechanisms, which may be encountered and must be satisfied either or both before or after the functional steps of the present invention are performed in order to gain access to a device.

[0010] These and other features of the present invention are discussed in greater detail in the section below titled DESCRIPTION OF THE PREFERRED EMBODIMENT(S).

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] A preferred embodiment of the present invention is described in detail below with reference to the attached drawing figures, wherein:

[0012] FIG. **1** is a perspective view of a monitoring system in accordance with a preferred embodiment of the present invention;

[0013] FIG. **1***a* is a plan view of the system shown in FIG. **1**, particularly illustrating the communications between the entities;

[0014] FIG. **2** is a schematic flow diagram of a preferred method of operation of a first preferred embodiment of the system;

[0015] FIG. **2***a* is a schematic flow diagram of an alternative of the operation described in FIG. **2**;

[0016] FIG. **3** is a schematic flow diagram of a preferred method of operation of a second preferred embodiment of the system; and

[0017] FIG. **4** is a schematic flow diagram of an alternative of the method of operation described in FIG. **3**.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0018] With reference to the figures, a system and method is herein described and otherwise disclosed in accordance with a preferred embodiment of the present invention. Broadly, the present invention concerns a system and method for controlling telematic access to, and especially protecting against unauthorized attempts to provide input to or elicit output from, a vehicular or other mobile device. In a preferred embodiment, protection against unauthorized attempts are determined by the location of the originating request source. The invention provides a basis or an additional basis for allowing or denying the attempt at access. Though described hereafter in terms of a vehicular device located onboard or otherwise associated with a vehicle, it should be understood that the present invention can be used to control access to substantially any mobile device, such as a mobile telephone or a mobile computing device (e.g., laptop, notebook, personal digital assistant).

[0019] In general, the present invention provides a monitoring system **10** and a method of using source location to deny telematic access to a vehicle **12**, such as a car or truck, adapted for use with the system **10** (see, FIG. **1**). The determined location of a requesting source **14** provides a basis for denying or accepting the attempt at access. Preferably, the monitoring system **10** of the present invention is used to supplement one or more other independent access-control mechanisms, such as physical, password, or cryptographic authentication mechanisms, rather than as a standalone alternative to those mechanisms. For example, accessing a particular device may require both that the party attempting to access the device provide a correct password and that the mobile device and party attempting to access the device are located at an authorized location, such as, e.g., a manufacturing or assembly facility, dealership, toll booth, or authorized repair facility.

[0020] Referring to FIGS. **1** and **1***a*, a first preferred embodiment of the system **10** includes at least one receiver **16** positioned, oriented and/or configured, so as to define a safe zone **18**, wherein requests are detected by the receiver(s) **16**, and the zone **18** is based upon the receptive range of the receiver **16**. More preferably, a plurality of receivers **16** are positioned and cooperatively configured to present an overlapping zone **18** that redundantly encompasses at least a portion of the area for which protection is sought. As shown in FIGS. **1** and **1***a*, the zone **18** may be further defined by physical structures such as walls, wherein the receivers **16** are configured to receive and protect against only communications entering the indoor spaces defined by these walls. It is appreciated, that this configuration limits interference within the system **10** and reduces unnecessary processing of exclusively exterior-zone communications.

[0021] The preferred receivers **16** are selected and/or configured so as to be able to receive a wide range of telematic communication channels within the zone **18**, and in doing so, may be identical or present various configurations. For example, the system **10** may comprise receivers **16** operable to receive RF, cellular or other technology based communications, and each may be configured to receive a different range of communication channels. In a preferred embodiment, the receivers **16** detect all short range communications within the zone **18**, and are cooperatively configured with a controller **20** to determine and block those communications or requests **22** that originate outside of the zone **18**, irrespective of their channel. More preferably, in this preferred embodiment, the controller **20** is communicatively coupled to the authorized communication network (not shown) within the zone **18**, and may be hard-wired or wirelessly coupled to the network, such that a request **22** emanating from an authorized node within the network is autonomously determinable by the controller **20**.

[0022] More particularly, in this configuration, the system **10** is configured to determine network activity, i.e. whether a network transmitter has transmitted a request, within the period of potential promulgation of the request **22**. If the system **10** detects network activity during the period of potential promulgation, it assumes that the request **22** emanated from the network, and therefore ignores the request **22**. It is appreciated that the period of potential promulgation of a wireless communication is readily determinable by one ordinarily skilled in the art, and that this period varies according to the communication technology. As such a temporal range for this period is not provided herein with the understanding that the preferred system **10** operates in real-time, i.e. without undue delay, so as to effectively block unauthorized requests.

[0023] Alternatively, where the system **10** is configured to determine the address of a detected request **22**, a list of the approved communication node addresses within the network may be manually inputted into or otherwise determined by the controller **20**. The controller **20** is further configured to compare the source address of a detected request **22** to the list, and cause the request **22** to be blocked, if the source address is not found in the list.

[0024] It is also within the ambit of the present invention to manually enter addresses from one or more outside authorized zones (not shown) into the system **10**, so that requests therefrom are also not blocked. The entries in the authorized zone database may be categorized with respect to the type of access for which each such location entry is authorized. Thus, for example, the location of a repair facility or dealership may be an authorized location for programming an ECU and for eliciting identification information but not for eliciting other information, thereby allowing a later received but paid for software update to be transmitted to a customer's vehicle at his or her residential garage.

[0025] Under either configuration, the preferred controller **20** is also configured to cause to be sent an objection message **26** back to the source **14**, if the request **22** is deemed unauthorized. To prevent repeated unintentional communication attempts, the objection message may include indicia readable by a user at the source location, such as "UNAUTHORIZED COMMUNICATION ATTEMPTED." More preferably, the controller **20** is further configured to cause to be sent a report **28** of the unauthorized request to a law enforcement agency **30**, wherein the report **28** identifies the source **14** and the nature of the unauthorized communication attempt. Thus, the controller **20** is preferably communicatively coupled to a short-range transmitter **32** (for communicating back to the source **14**), and long-range or cellular communication device **34** (for communicating to the agency **30**). The period necessary to determine the authorization status of the request **22**, and communicate the blocking message **24** to the device **12**, shall be referred to as the "period of manipulation."

[0026] Thus, a preferred method of operation begins at a step **100**, wherein an authorized node address list is entered into the controller **20** (see FIG. 2). At a step **102**, the receivers **16** detect a request **22** within the zone **18**. At a step **104**, the controller **20** determines whether the request **22** originated from within or outside of the zone **18**, by comparing its source address with the authorized list. If disseminated from a source having an address not included within the list, then the controller **20** causes the request **22** to be blocked at a step **106***a*, and may then return to step **102** in order to continue monitoring. More preferably, at step **106***a*, the controller **20** broadcasts or otherwise sends to each mobile device or vehicle **12** within the zone a blocking message **24**, which instructs the vehicle **12** to disobey the unauthorized request **22**.

[0027] The device or vehicle **12** is, therefore, adapted for use with the system **10**, and further includes a communication device **36** that is communicatively coupled to the transmitter **32** of the monitoring system **10**. The in-vehicle communication device **36** is configured to receive data transmissions from the system **10**, and also to receive the request **22** contemporaneously with the receivers **16**. An in-vehicle ECU **38** is communicatively coupled to the vehicle communication device **36** and configured to sequentially receive the request **22**, wait a predetermined period not less than the period of manipulation, and conditionally perform or accept the requested action, if a blocking message **24** is not received or detected during the waiting period. As such, the vehicle **12** further includes suitable hardware, software, firmware, or combination thereof, to perform the intended functions.

[0028] In the alternative where the controller **20** is hardwired or otherwise communicatively coupled to the authorized communications network within the zone **18**, once a request **22** is received by a receiver **16**, and transmitted to the controller **20**, the controller **20** determines whether the network has been active during the period of potential promulgation, i.e. a network transmitter is currently transmitting or has recently transmitted a request (see, FIG. **2***a* modifying FIG. **2** by omitting step **100**, and supplanting step **104** with step **104***a*). As previously mentioned, in this mode of operation, if network activity is not detected during the period of potential promulgation, then the controller **20** causes the request **22** to be blocked at a step **106***a*, and may then return to step **102** in order to continue monitoring.

[0029] More preferably, as shown in FIGS. **2** and **2***a*, and at a step **108**, if the request **22** originates outside the zone **18**, the controller **20** further causes an objection message **26** to be sent to the source **14**, and a report **28** to be sent to an agency **30**, prior to returning to step **102**. If the request **22** originates from within the zone **18**, then the controller **20** ignores the request **22** at step **106***b* allowing it to be delivered to the vehicle or mobile device **12**, and continues to monitor the zone **18** by returning to step **102**.

[0030] In a second preferred embodiment of the invention, the receivers **16**, controller **20**, and short-range transmitter **32** of the system **10**, may be further configured to cooperatively determine the presence and communication channel of a mobile device or vehicle **12** within the zone **18**, determine the transmission channel of the request **22**, and transmit a blocking message **24** to the vehicle **12**, only if the transmission channel and communication channel of the request **22** are congruent (i.e. substantially identical, so as to be able to carry the same message) and the source address indicates a source location outside of the authorized zone **18**.

[0031] The device or vehicle **12**, in the second preferred embodiment, is also adapted for use with the system **10**, and further includes a communication device **36** that define a communication channel and is communicatively coupled to the transmitter **32** of the monitoring system **10**. It is appreciated that this embodiment enables the system **10** to protect against unauthorized requests **22** directed to the mobile device or vehicle **12** channel, but allows short-range communications on other channels to enter the zone **18** without interruption.

[0032] A preferred method of operation in the second preferred embodiment is shown in FIG. **3**, and illustrates further features and functions of the system **10**. The method begins at step **200**, wherein the short-range transmitter **32** broadcasts a plurality of pings within the zone **18** at various channels, and each ping is identifiable by its transmitted channel. At a step **202**, the receiver **16** detects receipt of at least one ping by a mobile device or vehicle **12** located within the zone **18**, and the controller **20** is configured to determine and store the transmitted channel of the received pings. Alternatively, however, and similar to the first preferred embodiment, where a limited number of mobile devices or vehicles constantly present a limited number of communication channels within the zone **18** (e.g. residential garages, wireless office intranets), the monitored communication channels may be manually inputted, and stored, thereby skipping diagnostic steps **200** and **202**.

[0033] At steps **204***a* and *b*, the receiver **16** and vehicle **12** receive a request **22** having a transmission channel. At a step **206***a*, the controller **20** determines whether the transmission channel is congruent to the communication channel, while the vehicle **12** commences a waiting period at step **206***b* during which it determines whether a blocking message has been received. At a step **208***a*, if congruent, the controller **20** analyzes the request **22** to determine its originating source location, otherwise, if the channels are not congruent, and at a step **208***b*, the request **22** is discarded and the method returns to steps **204***a,b*. At a step **210**, the controller **20** further determines whether the originating source location is within the zone **18**. At a step **212***a*, if the source location is outside the zone **18**, the controller **20** generates and causes a blocking message **24** to be transmitted to the vehicle **12**. Otherwise, the controller **20** at a step **212***b* discards the request **22**, and returns to steps **204***a,b*. As shown in FIG. **2**, the waiting period at step **206***b* is of sufficient duration to allow steps **206***a* through **212***a* to be performed by the system **10**. At a step **214***a*, if the vehicle **12** receives a blocking message **24** associated with the request **22**, it discards its request **22** without performance or acceptance, and the method returns to step **204***a,b*. Otherwise, at a step

214*b*, if a blocking message **24** is not received after the waiting period, the vehicle accepts and/or performs the request **22**.

[**0034**] More preferably, at step **212***a*, the controller **20** further generates an objection message **24**, and causes the objection message **24** to be communicated to the source **14**. Most preferably, in addition to the objection message **26**, the controller **20** also generates a report **28**, and causes the report **28** to be communicated to a law enforcement agency **30**.

[**0035**] A second preferred method of operation of the second embodiment is shown in FIG. **4**, wherein the controller **20** and receiver **16** are cooperatively configured to detect only requests having transmission channels congruent with the communication channel of the device or vehicle **12**. In this configuration, steps **200** through **214***a,b*, with the exception of omitted steps **206***a*, and **208***b*, are repeated and referred to as steps **300** through **312***a,b*.

[**0036**] The preferred forms and methods of operation of the invention described above are to be used as illustration only, and should not be utilized in a limiting sense in interpreting the scope of the present invention. Obvious modifications to the exemplary embodiments and modes of operation, as set forth herein, could be readily made by those skilled in the art without departing from the spirit of the present invention. The inventor hereby states his intent to rely on the Doctrine of Equivalents to determine and assess the reasonably fair scope of the present invention as pertains to any apparatus not materially departing from but outside the literal scope of the invention as set forth in the following claims.

What is claimed is:

1. A method of controlling access to a mobile device within an authorized zone having a communications network, wherein said method is autonomously performed by an electro-mechanical system, the method comprising the steps of:

(a) detecting a wireless request within the zone;

(b) determining within a period of manipulation whether the request emanated from the network; and

(c) communicating with the mobile device within the period of manipulation, so as to cause the request to be disobeyed by the device, when the request did not emanate from the network.

2. The method as claimed in claim 1,

steps (b), and (c) further including the steps of communicatively coupling the system and network, such that the system is operable to detect network activity within a period of potential promulgation, and causing the request to be disobeyed, when network activity is not detected within the period of promulgation.

3. The method as claimed in claim 2, wherein the mobile device detects the request contemporaneously with the system, waits a predetermined period at least equal to the period of manipulation, determines whether a blocking message has been received during the waiting period, obeys the request only if a blocking message has not been received during the waiting period, and

step (c) further includes the steps of communicating a blocking message to the mobile device within the period of manipulation, which instructs the mobile device not to obey the request.

4. The method as claimed in claim 1,

steps (b), and (c) further including the steps of determining and storing a list of the authorized node addresses of the network, determining the source address of the request, comparing the source address to the addresses in the list, and blocking delivery of the request to the mobile device, when the source address is not found in the list.

5. The method as claimed in claim 4,

step (a) further including the steps of manually determining and inputting the addresses.

6. The method as claimed in claim 1, wherein the mobile device is a vehicle.

7. The method as claimed in claim 1,

step (a) further including the steps of detecting a wireless RF or cellular request.

8. The method as claimed in claim 1, wherein the system includes at least one receiver oriented and configured to detect a wireless request within the zone, a controller communicatively coupled to said at least one receiver, and at least one transmitter communicatively coupled to the controller.

9. A method of controlling access to a mobile device within an authorized zone, the method comprising the steps of:

(a) determining the presence of the mobile device within the zone;

(b) determining and storing at least one communication channel of the mobile device;

(c) detecting a wireless request within the zone, and determining the transmission channel of the request;

(d) comparing the transmission channel to the communication channel of the mobile device;

(e) determining the location of the originating source of the request, when the transmission channel is congruent to the communication channel; and

(f) causing the request to be disobeyed by the mobile device, when the originating source is located outside of the zone.

10. The method as set forth in claim 1,

steps (a) and (b) further including the steps of broadcasting within the zone a plurality of pings, wherein each ping is identifiable by and transmitted at a different channel, and detecting receipt of at least one ping by the mobile device, so as to determine the presence and communication channel of the mobile device.

11. The method as set forth in claim 1,

step (f) further including the steps of sending a blocking message to the mobile device, wherein said blocking message instructs the mobile device not to perform or accept the request.

12. The method as set forth in claim 11, wherein the mobile device detects the request, waits a predetermined period and determines whether a blocking message has been received, after detecting and prior to accepting the request, and accepts the request only when a blocking message has not been received during the period.

13. The method as set forth in claim 1; and

(g) sending an objection message back to the source, after denying the request.

14. The method as set forth in claim 1; and

(g) sending a report to a law enforcement agency, wherein the report informs the agency of the originating source location.

15. A method of controlling access to a mobile device within an authorized zone, the method comprising the steps of:

(a) determining the presence of the mobile device within the zone;

(b) determining and storing at least one communication channel of the mobile device;

(c) detecting only a wireless request having a transmission channel congruent with the communication channel;

(d) determining the location of the originating source of the request; and

(e) denying acceptance of the request by the mobile device, when the originating source is located outside of the zone.

16. The method as set forth in claim 15,

steps (a) and (b) further including the steps of broadcasting within the zone a plurality of pings, wherein each ping is identifiable by and transmitted at a different channel, and detecting receipt of at least one ping by the mobile device, so as to determine the presence and communication channel of the mobile device.

17. The method as set forth in claim 15,

step (e) further including the steps of sending a blocking message to the mobile device, wherein said blocking message instructs the mobile device not to receive, accept, or perform the request.

18. The method as set forth in claim 17, wherein the mobile device detects the request, waits a predetermined period and determines whether a blocking message has been received, after detecting and prior to accepting the request, and accepts the request only when a blocking message has not been received during the period.

19. The method as set forth in claim 15; and

(g) sending an objection message back to the source, after denying the request.

20. The method as set forth in claim 15; and

(g) sending a report to a law enforcement agency, wherein the report informs the agency of the originating source location.

* * * * *